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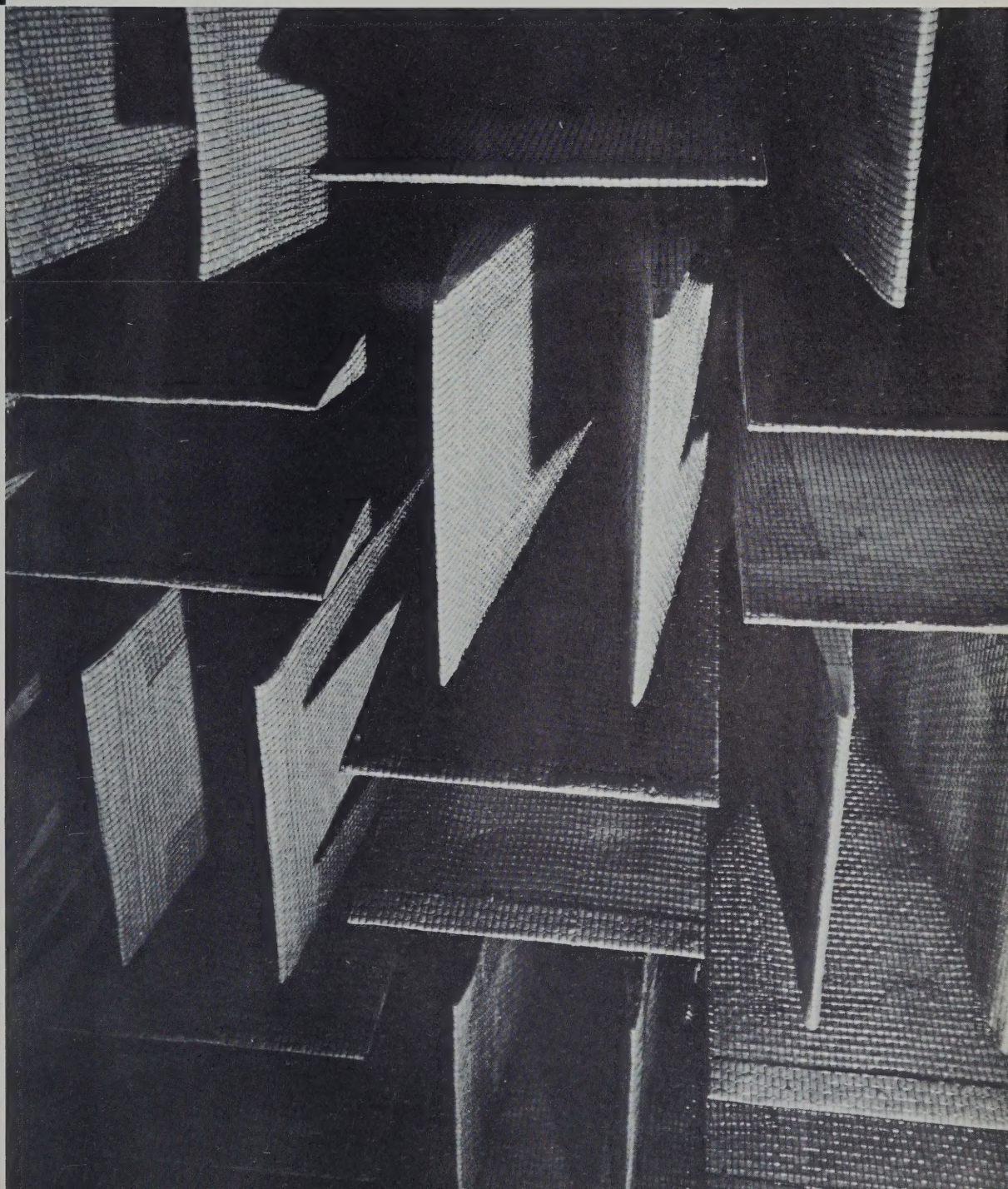
NATIONAL BUREAU OF STANDARDS

Technical News Bulletin



UNITED STATES DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

Technical News Bulletin

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NATIONAL BUREAU OF STANDARDS
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COVER: *Improved wedge structure designed at NBS and recently installed in the anechoic chamber. The 70-inch long wedges absorb more than 99 percent of the normally incident sound energy above 43 Hz.*

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The National Bureau of Standards serves as a focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. For this purpose, the Bureau is organized as follows:

- The Institute for Basic Standards
- The Institute for Materials Research
- The Institute for Applied Technology
- Center for Radiation Research
- Center for Computer Sciences and Technology

The TECHNICAL NEWS BULLETIN is published to keep science and industry informed regarding the technical programs, accomplishments, and activities of NBS.

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John Haines, of the NBS staff, positions pointer on hip joint to obtain data on position of seatbelt anchorages in relation to driver.

AUTOMOBILE SEATBELT ANCHORAGES SURVEYED

NBS Measures Restraint Anchorage Locations

THE NBS OFFICE OF VEHICLE SYSTEMS RESEARCH surveyed the locations of occupant restraint anchorages in most models of domestic cars for 1968, and again in the 1970 models, in research supported by the Department of Transportation. The weighted averages obtained for the anchorage locations have been used in standards by DOT,[1] the International Organization for Standardization,[2] and the Society of Automotive Engineers [3] and have been used by the Bureau in testing restraint components and systems. Conclusions based on these measurements are that anchorage locations don't differ much from year to year, and that few upper-torso restraint configurations now in use actually fit people comfortably or are easily accessible to the occupant. These findings reinforce the contention that occupant restraints should be designed with the car, not added to already-designed automobiles.

Johathan Haines, of the OVSR staff, surveyed 1968 domestic automobiles to determine just how the occupant restraint anchorage locations differed from car to car. He made measurements of anchorage locations on all major automobile body types, using the driver's outboard seatbelt anchorage as a reference. These data, when combined with information from the automobile manufacturers, provided information for most of the 358 different models produced. He then translated the dimensions for the anchorage locations so that the driver's mid-hip point became the origin for the measurements expressing them relative to the seat's occupant.

The data for each model of automobile were weighted in proportion to that model's share of total sales and a set of weighted averages was obtained that yielded a configuration most typical of domestic automobiles. This weighted average supplies the dimensions used in anchoring the seatbelt and upper torso harness on the Bureau's "sled" for dynamic tests of restraint systems, and is specified in domestic and international standards for testing the performance of restraint assemblies.

The survey was repeated on the 1970 domestic production automobiles. The weighted averages obtained for 1970 anchorage locations are not significantly different from the 1968 ones, confirming the earlier finding that anchorage locations were somewhat stylized and not significantly related to any dimensions of the automobile. In particular, the 1970 survey results show little change in location of the upper torso belt anchorage. The upper torso restraint is no more accessible or comfortable in 1970 models than in the 1968 models, and thus no more of an inducement for motorists to use it.

[1] Department of Transportation Motor Vehicle Safety Standard No. 213—**Child Seating Systems**, Jan. 1, 1971, and a proposed Federal standard for dynamic testing of seatbelt assemblies.

[2] International Organization for Standardization Draft Resolution ISO/TC 94/SC2–WG1–Dynamic Testing.

[3] S.A.E. Recommended Practice/Dynamic Test Procedure–Type 1 & Type 2 Seat Belt Assemblies–SAE J117.

RESEARCH ON HYDRAULIC BRAKE FLUIDS

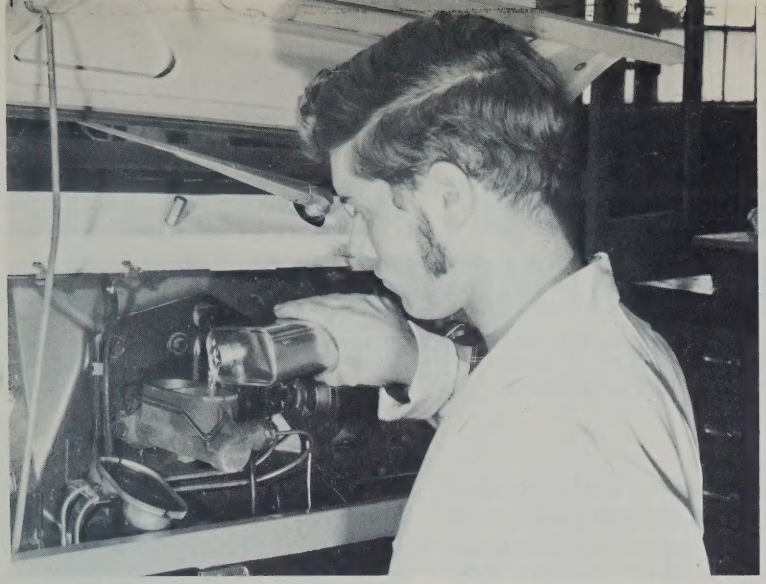
NBS Studies Lead to New Federal Standard

THE OFFICE OF VEHICLES SYSTEMS RESEARCH of the NBS Institute for Applied Technology has been studying components of hydraulic braking systems, essential to automotive safety,[1] in research for the Department of Transportation. This work has shown that hydraulic fluid is greatly degraded by the water it invariably picks up, and the necessity of specifying how a fluid should perform after two or three years in use. A result of this program is the issuance by DOT of a proposed new Federal standard for motor vehicle brake fluid.[2]

Hydraulic Brakes

Hydraulic brakes were first placed on the market in 1924 and by 1936 were found on all automobiles produced in this country. Brake design has since changed radically, as evidenced by the introduction of disk brakes and split hydraulic systems, but hydraulic brake fluid is still used by all cars. The Federal Government first published a procurement specification for it in 1938 and in 1963 set standards for all brake fluid sold in the United States.

Conventional brake fluid, typically a blend of high-molecular-weight, high-boiling polyglycols and solvents, is formulated to offer a happy medium between incompatible characteristics; it must not boil when hot and must



Robert Bussink pours new brake fluid into the master cylinder reservoir of a truck being placed in use by the Chesapeake and Potomac Telephone Company. The phone company is cooperating with the NBS Office of Vehicle Systems Research by permitting it to take regular samples from the brake fluid in 22 of its trucks. The samples will be analyzed for water content in research for the Department of Transportation.

remain sufficiently fluid when cold. Mandatory Federal standards effective in 1963 established specifications for conventional, high-temperature, and arctic grades of fluid. A higher boiling point was specified for the high-temperature grade and lower viscosity for the arctic grade; the conventional fell between these extremes.

By the time the first mandatory Federal standards appeared, automotive engineers were aware that the presence of water in brake fluid markedly degraded its performance by increasing its viscosity and lowering its boiling point. Even if a brake fluid was acceptable when placed in service, it might acquire as much as 10% water over the years. The absorbed water lowers resistance to brake line vapor locking, speeds corrosion of wheel cylinders, and makes cold weather performance more sluggish.

Brake Hose

How does water get into the brake fluid? OVSR tests disclosed that in today's sealed systems most of the water entering the system passes through the walls of the brake hoses—flexible connections to the brakes of each wheel. Brake hoses under test were filled with dry (less than 0.1% water) brake fluid, sealed at the ends, and maintained at 90 °F (32 °C) and 80% relative humidity for 30 days. Conventional fluids analyzed after this exposure contained 3–7% water, and low hygroscopic fluids about 1.5%. Surprisingly, brake fluid in used hoses picks up 8–22% less water than in new hoses; the cause of this phenomenon will be studied further and when known should be of interest to laboratories formulating rubber compounds.

Richard Radlinski threads a warning tag on a wire to be sealed around the master cylinder of a truck for a two-year test of brake fluids as Murrell Miller, of the Chesapeake and Potomac Telephone Company, looks on. The truck is a new one being placed in use by the telephone company, which is cooperating with the OVSR in tests of brake fluids for the Department of Transportation.

Vapor Lock Tests

The resistance of brake fluids to vapor locking is conventionally determined by the SAE equilibrium reflux boiling point test procedure. In this procedure the specimen fluid is heated in a condensate recycling vessel and the boiling point noted. OVSR believes this to be a poor way to measure resistance to vapor lock because the temperature noted is higher than that at which some volatile fractions vaporize. These fractions are critical in producing vapor lock.

OVSR is now studying laboratory techniques in which the temperature used is that at which the first bubble or small volume of vapor is formed. Another test procedure uses a dilatometer to identify the temperature at the time of critical expansion. Vapor lock temperatures obtained by the dilatometer method are being compared with those obtained by the SAE method, as well as with those associated with loss of pedal for a brake being run on an inertia dynamometer and in a test vehicle. Experimentation with the dilatometer indicated that the heating rate must be carefully controlled, the bath must be stirred in a controlled manner, and possibly that nuclei should be provided for vaporization.

Road Testing Brake Fluids

OVSR is starting to test several developmental as well as commercially available brake fluids in a fleet of vehicles that is on the road almost every day. The Chesapeake and Potomac Telephone Company is permitting the OVSR to replace the brake fluid in the phone company's new panel trucks with new brake fluid of known characteristics. The Bureau's technicians drain and flush the hydraulic system and replace all rubber components and hoses before putting in the new fluid. The master cylinder reservoir is then sealed; samples of fluid will be obtained from wheel cylinder bleed valves and from the master cylinder reservoirs at intervals during the two years that the test will be run. The data obtained from this experiment are expected to be useful in evaluating the magnitude of the water content problem and perhaps in identifying brake fluid formulations that best resist the water invasion.

[1] Braking systems research program, Nat. Bur. Stand. (U.S.) Tech. News Bull. **53**, 127–129 (June 1969).

[2] Department of Transportation Proposed Motor Vehicle Safety Standard No. 116, **Motor Vehicle Brake Fluids**, 35 F.R. 15229 (Sept. 30, 1970).

IMPROVED TECHNIQUE FOR POLYMER FILM MEASUREMENTS

A DIELECTRIC TEST CELL for measuring the electrical characteristics of polymers used as electrical insulation has been developed jointly by NBS and the American Viscose Division of FMC Corporation (Marcus Hook, Pa.)[1] The cell, used in measuring the dielectric constant of self-supporting films in the range 2–250 μm, provides a tenfold improvement in the uncertainty of the results over previously reported methods. In addition, standard methods were developed for measuring the dielectric constant, dissipation factor, and thickness of thin film polymers to better than 1 percent. The work was performed at the Bureau as an Industrial Research Associate Program.

With the assistance of M. G. Broadhurst, of the NBS Polymers Division, and the expertise of other Bureau scientific staff members and instrument makers, Research Associate Glen Oneal, Jr. (American Viscose Division of FMC) designed the cell now in service at FMC and NBS. In some respects the design is similar to that of a cell used at the Bureau to measure thick disks.[2] The principle is the same—a two-fluid, three-terminal scheme—but adapted to thin film measurements.[3]

Dielectric Constant

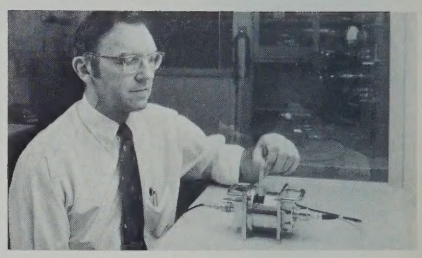
The technique of employing two fluids of different dielectric constant reduces the dielectric measurement problem to that of simply obtaining a series of direct capacitance measurements. Typically, since air is usually one of the test fluids, the series consists of four capacitance measurements: 1) the cell with air only; 2) the cell with air plus specimen; 3) the cell with the second fluid (e.g., heptane) only; 4) the cell with the second fluid plus specimen. Using this method, the dielectric constant of the specimen is computed solely from these four measured capacitances and the known dielectric constant of one of the two fluids.

THE RESEARCH ASSOCIATE PROGRAM

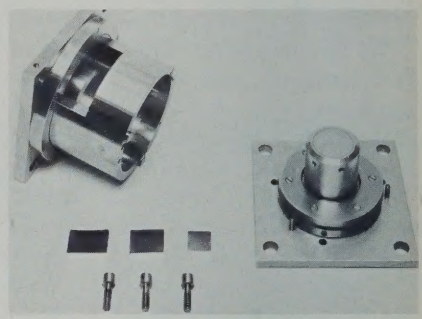
The FMC Corporation Research Associate Program at the National Bureau of Standards is one of almost fifty such programs sponsored at NBS by industrial, trade, and professional groups since 1965. During this period a diversity of organizations have thus availed themselves of the Bureau's facilities and the professional guidance of its staff.

A Research Associate, selected from the staff of the sponsoring organization, normally spends one to two years or longer at NBS working toward the solution of a specific problem of mutual interest to his organization, to the industry, trade or profession represented, and to the Bureau. The uniquely broad range of scientific endeavors and measurement technology at NBS are available to guide and assist the Research Associate in his work. He, in turn, brings to Government knowledge of both the latest advances and current problems of private industry, thereby enabling the Bureau to program its own efforts more effectively and increase its responsiveness to public and industrial needs.

The NBS Office of the Associate Director for Programs (Dr. Howard E. Sorrows) is the focal point for the Research Associate Program and liaison between industry and the Bureau. Any industrial organization, trade or professional association wishing further information on the Program may write to Mr. P. R. de Bruyn, Industrial Liaison Officer, Room A402, Administration Building, National Bureau of Standards, Washington, D.C. 20234.



Glen Oneal, Jr., places a sample of polyester film between the electrodes of the NBS–FMC dielectric cell, which provides a direct capacitance measurement of the film. This "clean station" ensures dust-free measurements.



The NBS–FMC two-fluid, three-terminal dielectric test cells for thin films shown with structurally independent parts separated. The three shims and screws accurately separate and aline the electrodes to the spacing desired.

Thickness Measurements

Having determined the dielectric constant of the specimen and the area of the cell electrodes, these values can be used to calculate the average thickness of the thin polymer film. The thickness of a 25 μm film can be measured to better than 1 percent uncertainty (0.18 percent standard deviation), better than can be obtained by either optical or mechanical means. The NBS–FMC technique bypasses the difficulties associated with these two methods; that is, neither optical (irregularity of the film surface)

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SUPERCONDUCTIVE TRANSITIONS SUITABLE FOR THERMOMETRIC FIXED POINTS

SCIENTISTS AT THE BUREAU have studied the superconductive transitions of annealed wire samples of lead, tin, indium, aluminum, gallium, cadmium, and zinc to determine their suitability as thermometric fixed points.[1] In this work by J. F. Schooley and R. J. Soulen, Jr., of the NBS Heat Division, most of the specimens exhibited superconductive transitions sharper than one millikelvin. The transitions were also reproducible to a millikelvin after numerous thermal cycles over a twenty-month period, pointing up their potential for use as thermometric fixed points.

The narrow temperature range within which certain metals change from the normal to the superconductive state has been suggested by several investigators for use as thermometric fixed points. Such fixed points could serve two useful functions between 0.01 and 20 K. First, they could easily be attached directly to apparatus used to determine absolute temperatures, permitting comparison of the transition temperature readings between laboratories with a sensitivity of better than one millikelvin. Second, fixed-point samples could be attached to experimental cryostats to provide in situ calibration of secondary thermometers; this technique should be particularly valuable for experiments conducted in the new helium-three dilution refrigerators,[2] since the usual helium vapor pressure-temperature calibrations are extremely difficult in these devices. For both functions, however, long-term reproducibility is a prerequisite.

To ascertain this reproducibility, wire samples of Pb, Sn, Al, Zn, and Cd obtained from the NBS Office of Standard Reference Materials, and commercially-obtained In and Ga, were evaluated. The samples were vacuum cast with a diameter of 2 mm and length of 3 cm. All specimens were annealed prior to the testing.

The samples were attached to copper mounts by varnish. The sample mounts were then screwed into a copper disk together with a set of germanium and carbon resistance thermometers and a heater. A control circuit using the carbon resistors and the heater maintained the disk temperature with a stability of about 0.2 mK. The temperature of a surrounding shield was kept a few hundredths of a kelvin below the disk temperature.

The transitions were observed with a mutual inductance bridge operating at 270 Hz, using short secondary coils to avoid sample end effects. The resistances of the germanium thermometers were measured by comparison with a 1000-ohm standard resistor, using a six dial potentiometer. The potentiometer detector output was fed to

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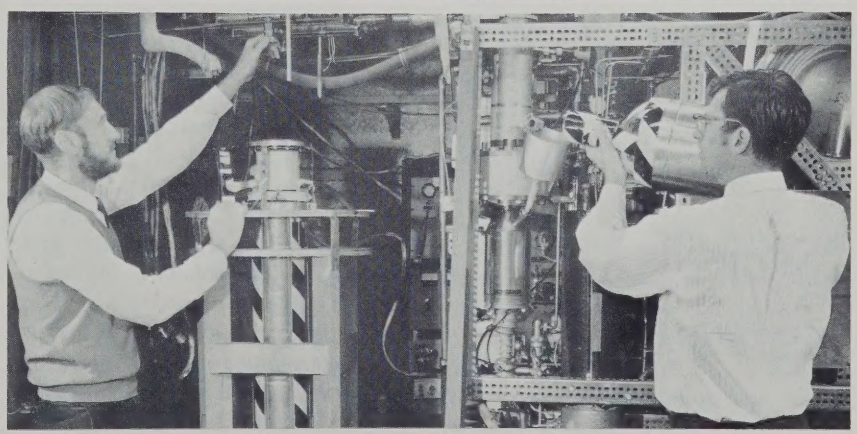
Table 1.

Sample	Source	Transition Width (mK)	Transition Reproducibility (mK)
Pb	OSRM 981	0.3	1
Sn	OSRM lot #6779	2 (Dec. 68) 10 (July 70)	1 (midpoint)
In	Incoa 5 N	0.7	1
Al	OSRM 6 N	0.5	1
Ga	Alcoa 6 N	0.6	1
Zn	OSRM 6 N	1	1
Cd	OSRM B-3	1.5 (Oct. 68) 7 (July 70)	



Drs. James Schooley (left) and Robert Soulen prepare the apparatus used to study superconductor transition temperatures.

THE FUTURE OF INTERNATIONAL STANDARDS

A condensation of the acceptance speech by Mr. Francis L. LaQue upon election as President of the International Organization for Standardization on September 25, 1970 at Ankara, Turkey. Mr. LaQue, Vice President of the International Nickel Co., is also President of the American National Standards Institute.

The fact that the next President of ISO will be from the United States has some important connotations, one being the confidence of the other Member Bodies of ISO in the maintenance of a strong and growing interest on the part of the United States in the work of ISO. A collateral aspect is firm evidence of the determination of the United States to play its proper role in international standardization as a major factor in eliminating nontariff barriers to trade, thereby promoting a higher level of international commerce from which all nations can expect to benefit.

Before making myself available as a nominee for this office I canvassed both industrial and governmental circles and secured enthusiastic support for the opportunity that would be provided in this way for the United States to demonstrate the high level of interest in, and support for, ISO that will be symbolized by having someone from the United States serving as President.

Increasing Need for International Standards

ISO will soon be celebrating the 25th anniversary of its organization to serve as a major factor in the promotion of trade among nations to advance their prosperity and increase their interdependence. Both of these are major factors that can contribute to peace in the world, the principal objective of the United Nations, which inspired the creation of ISO in 1947. It seems unlikely that the organizers of ISO could have foreseen how much the need for its work and the opportunity for it to be useful would have increased since it was established.

This expansion of opportunities stems in large part from what has been called "the compression of time." This compression includes:

- the speed with which scientific discoveries become important industrial activities and spread from one country to another;
- the tremendous advance in facilities and reduction in time required for communication by cables, radio and satellites and for transportation by air, land and water over tremendous distances;
- the growth in the number of multinational companies undertaking activities in many countries;
- the increased rate of industrialization and advance in the standards of living in many countries and the contribution to this through technology transfer that is made by the condensation and encapsulation of so much immediately usable data and "know how" represented by the technical content of standards;
- the growing need for standards covering a much broader spectrum of interest and scope than the primarily industrial standards that principally engaged the attention of ISO in its early days.

We now face the need for many more standards that serve the interests of the "man in the street" consumer who seeks guidance in the recognition of value and the assurance of safety in what he purchases for his personal use.

We can anticipate greatly increased requirements for international standards and methods of test that will be needed to deal with control of pollution of the air, waters and lands. Many, if not most, forms of pollution have no national boundaries. The air moves from nation to nation and continent to continent. Pollutants that enter streams in one country find their way into rivers, lakes and oceans that border other countries and affect the world at large. Internationally accepted methods of test to identify the nature and quantities of pollutants are required as a basis for development of effective systems of monitoring and means of controlling environmental pollution.

We can anticipate a need for more and better international standards in the general area of worker health and safety and human welfare in general. While there are reasonable standards for mechanical, thermal and electrical hazards, very little has been done on toxic materials and other industrial health and hygiene factors.

We can anticipate an extension of activities concerned with the tools and mechanics as distinct from the substance of trade and commerce. Such tools are represented by business machines, credit cards and checks forms. We might even come to deal with coinage systems designed more specifically for use in automatic vending machines and to avoid such machines accepting coins from different countries having significantly different value.

Priority to International Standards

There are many reasons for acceleration in the rate at which international standards can be made available. The best short cut to an international standard is to develop one in the first place rather than go through tedious procedures to reconcile differences among national or regional standards.

We should adopt a global approach to national standards in preference to a national approach to global standards. The direct international approach will be appealing to both industrial management and governments from which ISO must obtain greater support. Industries will wish to effect the savings in manpower, travel time and administrative costs that will be a direct result of a primary international approach. Government regulatory bodies—both national and international—will be more apt to reference ISO standards and stop duplicating ISO's work if needed standards are available on a timely basis.

Regional Organizations

My experience as Vice President of the Pan American Standards Commission, a group concerned primarily with standardization activities in Latin America, has identified some of the issues that must be dealt with in relations of developing countries with ISO. It seems likely that the matters of concern are not peculiar to the Latin American region but can be anticipated in other regions composed principally of what are called "developing countries."

Without meaning to do so ISO appears to have unwittingly drifted toward becoming an Institution catering to, and organized to deal with, the standardization needs of highly industrialized nations.

If, as it should, ISO is to serve as a truly international institution, improved ways and means must be found for more direct and more extensive participation by developing nations. These ways and means must take into account the limited ability of developing nations to pay dues, to contribute technologically to the development of standards, or to travel extensively to Western Europe where some 60–70% of all ISO technical meetings are held.

Just how this can be handled most realistically and to best advantage is not immediately evident. It seems likely, however, that some arrangements involving regional participation and representation both financially and technically will need to be given further serious consideration.

These comments with respect to regional arrangements should be limited specifically to dealing with the problems of regions made up of "developing" countries. Regional activities must not be of a nature that would lead to the creation of blocs of power to promote the special interests of certain regions in competition with others. This would be at the expense of the truly international standardization purposes for which ISO was established and which should continue to be its principal reason for existence.

Cooperation With Government Agencies

There is a frequent need for standards which are given the force of law by incorporation, by reference or otherwise to implement codes or other regulations. National, regional and international bodies or their agencies which draft agreements and regulations cannot regularly be expected to have the special knowledge and competence in standards development that are required to insure that the needed standards will have the sound technical and economic basis required for fair and effective regulation.

The preferred practice is to make use of available and applicable national or international standards developed by recognized standards organizations. In the absence of such available standards the cooperation of national or international standards organizations should be enlisted in recruiting competence from government and private sources to undertake standards development projects which may be required. Such organization of competence, both from government and private sectors, is preferable to unilateral efforts in either sector.

A commonly stated reason for acting independently of existing national or international standardization organizations is that the established procedures of these organizations may result in delay in providing standards that are urgently needed. It is true that it is easier by arbitrary action to create instant standards. Many, however, are likely to be of dubious quality since they lack the detailed consideration of all relevant factors that is necessary for the development of sound standards. Another major difficulty is that it is difficult if not impossible for other than standards developing organizations to enlist the voluntary participation of informed individuals representative of all interests that are likely to be affected.

Great progress has been made by ISO in this regard. ISO is certainly as capable, if not more so, of timely action than are most other international groups. Administrative details and procedures that add to the time required for the development and recognition of standards are capable of revision to speed up the process. This should be the subject of intensive study by ISO to develop an overall program of improved communication and methods by which it and its Member Bodies can respond more effectively to the needs of national and international organizations in the development of standards to be incorporated in treaties, codes and regulations. I was pleased to see that a comprehensive study is being conducted of ISO liaison with their international groups. I believe ISO can be most effective if we can enlist the cooperation and participation of international treaty and non-treaty groups desiring standards primarily by motivating them to turn to ISO rather

than attempt to find substitutes for and duplicate this organization's facilities and effective programs.

Certification Program

Action has already been initiated in ISO to deal with needs of consumers which can best be satisfied by some means of certification of compliance with appropriate standards. Realistic certification is especially needed by the ordinary "personal" consumers who do not have the means of independent verification of compliance by manufacturers with safety or performance standards. A good certification program must include sampling and quality control or evidence of it, particularly in the case of items manufactured in large quantities.

As in the case of standards, the tremendous advantage of an international approach over a regional or national approach to certification should be sought at the outset in contrast to later efforts to reconcile the differences among national and regional programs. The essence of this international approach is, of course, to base certification programs on international standards in the first instance. ISO must eventually develop criteria or standards for mutual recognition and acceptance of national certification and quality assurance programs. An effective program will require development of more performance standards and universally accepted testing methods. In our efforts to develop performance standards we must give appropriate consideration to the circumstances of use to which a product may be subjected. Where possible, testing methods should be developed by which probable and predictable performance can be measured.

Needed Improvements in ISO

It seems fairly obvious that for ISO to deal most effectively with the new and greater requirements in international standardization that have been mentioned some new approaches and new procedures will be required. I hope to stimulate attention to these needs with the guidance of the ISO Member Bodies.

ISO may require a substantial increase in operating budget. However, complete implementation of divisional councils and more effective and efficient organization of existing committees will measurably improve ISO's performance. We must explore all avenues with the cooperation of our Secretary General, who has already impressed me with his great energy, ability, imagination and dedication.

There must be continuing study to determine if more services to committees cannot be carried out by the Central Secretariat. The costs and benefits of centralizing more ISO functions must be objectively considered on the basis of international need, not merely on national practice or traditional concepts. If the need for international standards results in an increased ISO budget, there must be a re-examination of sources of the funds. The underlying objective must be to assure not only that needed funds will be provided on a secure and continuing basis, but also that costs will be distributed fairly among those who benefit from ISO efforts.

Broadening of the basis of support may include more direct industrial as well as governmental sources. This should bring with it more participation by industry representatives in the policy councils of ISO and in the planning of its programs. Certainly a broad spectrum of views is required on program priorities and new projects proposed for initiation.

Relations Between ISO and IEC

Continuing progress must be made in cooperation between ISO and the International Electrotechnical Commission (IEC). Noting that both of these organizations are devoted to taking care of world needs for international standards, one not familiar with the background could hardly be blamed for inquiring why these are

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nor mechanical (softness, compressibility) qualities of the material have to be considered with the new technique.

Dissipation Factor

Dissipation factor (or conductance) measurements are usually made simultaneously with the four capacitance values previously described. These yield the dissipation factor of the specimen. The increased sensitivity in the measurement of this characteristic by the NBS–FMC method is useful for today's improved polymer materials, where the dissipation factor has been lowered significantly. The dissipation factor is often used as a check on the constancy of quality in the production of polymer materials.

Polymer Film Standards

As a result of this research, NBS is in the process of producing polymer film standards of dielectric constant, loss, and thickness for ultimate issuance as Standard Reference Materials. The polymer film standards will be made available to industry for in situ calibration of instrumentation and procedures, where the need for such materials is well recognized. Testing laboratories could also make use of the NBS–FMC type of cell to evaluate accurately dielectric reference standards.

[1] Oneal, G., Jr., and Harris, W. P., **Three-terminal cell for thin film dielectric measurements,** Annual Report, Conference on Electrical Insulation and Dielectric Phenomona, NAS–NRC, pp. 164–170 (1969).

[2] Harris, W. P., **Precise determination of the area of guarded electrodes for accurate dielectric measurements on solid-disk specimens,** Annual Report, Conference on Electrical Insulation, NAS–NRC, pp. 71–73 (1963).

[3] Harris, W. P., and Scott, A. H., **Precise measurement of dielectric constant by the two-fluid technique,** Annual Report, Conference on Electrical Insulation, NAS–NRC, pp. 51–53 (1962).

NEW METHOD OF THERMAL ANALYSIS MEASURES PRODUCTS NOT REACTANTS

An apparatus has been developed by R. J. McCarter of the Office of Flammable Fabrics for measuring the rate at which vapors are evolved during the thermal degradation of materials.[1] The data obtained by this method indicate the kinetics of pyrolysis reactions much better than does the convenionally used method of recording weight loss of resident solids. The apparatus should prove highly useful for characterizing the thermal degradation of fabrics and thus aid in the development of standards to increase the safety of wearing apparel and interior furnishings.

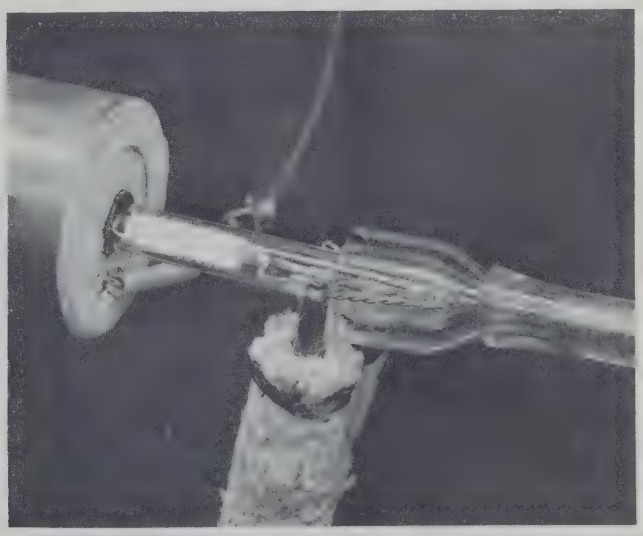
The apparatus is novel in its use of a high-temperature zone for converting condensable or tarry vapors into noncondensable form to avoid deposits. An advantage of the system is that the reaction velocity is recorded directly in the apparatus, eliminating computations from an integrated record. The system is simple, easy to operate, flexible, and permits a new freedom in programming the reaction temperature. This freedom, and options in the metering function, have been useful in segregating overlapping reactions that were not separable by conventional methods.

In the new apparatus, inert carrier gas is passed over the sample material centered within a tube furnace. Samples of 10 to 20 mg mass are generally used. A minute thermocouple immersed in the sample measures the pyrolysis temperature. Volatiles evolved from the sample with increasing temperature are carried to a cracking coil and subjected to thermal decomposition for reduction of "tars" to noncondensables. The flow is then conducted to any instrument suitable for metering the mass flow rate of the pyrolyzed vapors, such as a continuous gas analyzer, gas detector, flow meter, or a combustible gas indicator.

The system's performance has compared favorably in tests to that of thermogravimetry analysis (TGA). However, it accommodates reaction rates extending to a higher range than those commonly used with TGA. Heating rates of up to 2 °C per second have been employed. Another advantage of the apparatus is a sensitivity of up to two orders of magnitude greater than that of prior methods. Reaction heat effects are detectable in some modes of operation; that is, the apparatus has a capability for simultaneous differential thermal analysis. Some cellulosic samples during pyrolysis in the apparatus have indicated differences of up to 30 °C from the temperature of the immediate environment. This indicates the appreciable errors that may occur in the methods where the temperature sensor is near but not in the sample.

[1] McCarter, R. J., Apparatus for rate studies of vapor producing reactions, Proc. Symp. on Current Status on Thermal Analysis, National Bureau of Standards, Gaithersburg, Md., April 20–21, 1970.

R. J. McCarter positions a specimen, with a thermocouple attached, in the sample holder of the appartus.



Close up of the nichrome "cracking coil" for converting condensable or tarry vapors into noncondensable form.

COMPUTER PROGRAM MANIPULATES AND PLOTS DATA

Speed Aids Project Phoenix

THE CENTER FOR COMPUTER SCIENCES AND TECHNOLOGY is using a computer program called SPEED—*S*ystematic *P*lotting and *E*valuation of *E*numerated *D*ata—to manipulate and plot data obtained from sequential scans of up to 120 laboratory sensors.[1] NBS mathematician John M. Smith developed SPEED for use by the Bureau's Building Research Division in measuring strains and dimensional changes in structural materials and assemblies under stress. This computer program is also used on biological data obtained from stressed human subjects and should be useful to other scientists having to manipulate and analyze detailed data recorded from scans of many sources.

Recording Data

Performance testing of structures produces many channels of data, which are scanned repeatedly as the test progresses. Digital computers are ideal tools for analyzing such masses of data, and scanning systems now in use convert the analog data into digital form and record them for subsequent analysis.

Analyzing these data requires programs for use with the digital computer; SPEED is such a program for processing the data to facilitate their interpretation. This program contains 11 subprograms and operates in three phases, called PLOT1, PLOT2, and PLOT3.

Operation of SPEED

PLOT1 produces printouts of the data before and after processing, and also plots datum points. The input to the computer is usually magnetic tape that has been transcribed from the paper tape encoded in the laboratory. The computer first converts the data into machine language, arranges them in a matrix (the present one is 120× 100), and converts readings where desired to differences from the initial reading. It also prints out a specific warning if an instrument fails to record on a scan, if a value exceeds the range stipulated for a sensor, or if precision-check constant readings have varied more than one-half percent. A printout of the precision check warning alerts the scientist to the possibility that readings of all instruments are in error, as might occur because of a power line voltage surge.

PLOT1 produces a graph of the readings of each sensor against the readings of Channel 1. The input to Channel 1 is an independent variable—normally a clock or an instrument measuring applied force. These graphs may in some cases be all that the scientist requires.

PLOT2 manipulates and combines readings of instruments to create data in new channels (up to a maximum, including the input channels, of 120). It uses the matrix of data formed in PLOT1, but can accept also raw data encoded on punched cards. Operations that it can perform are: addition, subtraction, multiplication, and division by constants and by values in the matrix, as well as exponentiation of values by a constant. The scientist can select point plots of any one channel against any others, expanding plots as desired through use of the arithmetic operations.

PLOT3 uses proprietary software (programs) to draw any of the plots obtained in PLOT2 as high quality graphs, suitable for use as copy for printing.

Applications

SPEED has been extremely useful to the Bureau's Building Research Division in its tests of masonry walls, concrete beams and slabs, and composite structures. A preliminary version of the program was used in evaluating the performance of a housing module for Project Phoenix to assure Detroit building code authorities that proposed novel design features did not impair performance.[2] It is now being used in Operation Breakthrough, another approach to mass housing being evaluated at the Bureau for the Department of Housing and Urban Development. SPEED is also being employed by the Heat Stress Laboratory of the Naval Medical Research Institute to process masses of recorded physiological data obtained from subjects working in extreme heat.

[1] Smith, J. M., Automatic data evaluation, manipulation, display, and plotting with SPEED, Computer Graphics (in press).

[2] Performance of low-income housing: Phoenix project studied, Nat. Bur. Stand. (U.S.), Tech. News Bull. 53, 84–85 (Apr. 1969).

James W. Raines prepares to record data from the many sensors attached to a precast concrete beam-column connection.

SOLID STATE CALORIMETER FOR LASER ENERGY MEASUREMENT

FOR SOME EXPERIMENTS it is necessary to simply and accurately measure the output energy of a solid state laser. A physicist at NBS has developed a portable calorimeter that provides measurements of laser energy accurate to within 3 percent at energies up to 100 joules. The calorimeter was designed and developed by A. H. Neill, Jr., of the Institute for Materials Research, with support from the Strategic Technology Office of the Advanced Research Projects Agency.[1] The compact device, measuring 14 x 6 x 6 inches, and weighing about 50 pounds, was fabricated by John A. Mitchell.

The energy absorbed within the calorimeter is transformed into heat and measured by a series of thermocouples affixed both to the absorber and to a reference body kept at room temperature. The laser's energy is determined by intercomparing a calibrated value of the calorimeter's response with the response obtained from the laser beam being measured. The rise time absorption curve of the unknown laser, when replotted exponentially, can be extrapolated to time zero (the firing time) to give the response in microvolts. The calorimeter was calibrated, in microvolts per joule, by means of a laser whose output had been determined using the "standard" liquid calorimeter at NBS Boulder.

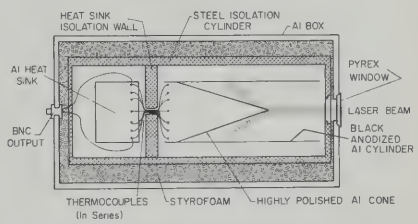
After measuring the energy of a laser beam with the NBS calorimeter, Arthur H. Neill, Jr. (rear of photo) draws in the base line for the signal versus time curve plotted on the X–Y recorder, and John A. Mitchell (right) readies the laser's power supply for the next shot. The laser is in the foreground with the calorimeter directly behind it between a microvolt amplifier (far left) and the X–Y recorder (right).

Design

The NBS calorimeter is divided into two major sections: the absorber and the heat sink.

Absorber. The beam enters the absorber and is rendered divergent by reflection off the outside surface of a hollow, highly polished aluminum cone (the center of the beam striking the apex) ; the reflected beam, having a substantially reduced energy density, is then absorbed in a black-walled aluminum cylinder surrounding the cone. The external surface of the cylinder is anodized to provide electrical isolation between 15 thermocouples connected in series and attached to the cylinder at the base of its outside wall. This arrangement provides high sensitivity and reduces the amplifier requirements for recording the temperature rise generated by a single laser flash. The cone-cylinder configuration is suspended by nylon screws within a stainless steel tube that serves as a thermal shield.

Heat sink. The cold thermocouple junctions are terminated on the anodized surface of the heat sink. The heat sink is a hardened aluminum cylinder suspended by nylon screws within the same stainless steel tube as the cone-cylinder absorption apparatus. The heat sink is thermally isolated from the absorber by a stainless steel wall. Only a small hole through the isolation wall enables the 30 thermocouple leads to pass from the heat sink to the cone-cylinder. The thermopile leads pass to the outside through a connector attached to the rear wall of the heat sink cavity.



Schematic diagram of the NBS laser calorimeter. The laser beam enters from the right and is centered on the apex of the cone. The beam is reflected by the cone and is absorbed in the black-walled cylinder, into which the cone is press fitted. The leads connecting the hot and cold junctions of the thermocouples pass through a stainless steel thermal shield; the thermopile output leads pass to the outside through a connector on the far left wall. The stainless steel tube containing both the cone-cylinder, and the heat sink, is seated in styrofoam and is encased in a portable aluminum housing.

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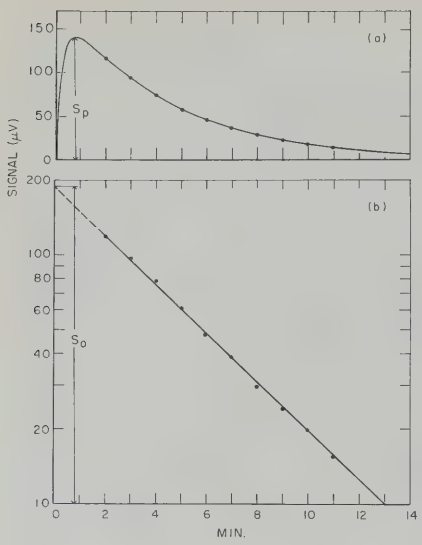


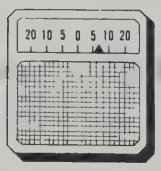
The upper graph (a) shows a rise time absorption curve of a laser beam obtained with the NBS laser calorimeter. When this is replotted exponentially (b), it can be extrapolated to time zero to give the maximum signal at the firing time. The maximum signal output can be compared to the calibrated value for the calorimeter to find the energy of the absorbed laser beam.

The entire stainless steel assembly, containing the absorber and heat sink, rests in styrofoam packing, encased within an aluminum frame.

Operation

A measurement is taken by flashing one pulse of the laser beam into the calorimeter. Most of the beam is absorbed by the black coating of the cylinder whose temperature rise is sensed by the thermopile. The thermopile voltage is amplified by a microvolt amplifier and sent to an X-Y recorder to plot the voltage as a function of the time required for the calorimeter to reach a maximum temperature and then cool. Intercomparison of the described instrument with a "standard" liquid cell calorimeter at the NBS Boulder labs showed measurement deviations of less than 2.8 percent. No signs of damage or deterioration in the internal structures were observed on direct exposure up to 71.5 joule flashes.

[1] Neill, A. H., Jr., High-energy light detector for use with pulsed ruby and glass lasers, Appl. Opt. **9**, No. 10, 2392–2393 (Oct. 1970).



STANDARDS AND CALIBRATION

NEW CALIBRATION SERVICE FOR THE VOLT

Volt Transfer Program Gives Improved Dissemination

THE BUREAU is now offering an improved service for the dissemination of the volt through a Volt Transfer Program. This new service, by the NBS Electricity Division, is designed to reduce the uncertainty of the assignment of the unit of voltage *at* the participating laboratory, and to provide the laboratory with quantitative information about its own measuring process.

The Volt Transfer Program is *not* designed to replace the present calibration service for saturated standard cells, but instead, is intended for those laboratories that need and can utilize a more precise unit of voltage than that now available. This service is a part of the Bureau's Measurement Analysis Program [1] (MAP) and was developed jointly with the United States Air Force and Army.

In the new service, rather than have standard cells sent to NBS for calibration as is usually done, the Bureau will provide transport standards of voltage, appropriate measuring techniques, and overall supervision of the experiment. And, as far as is practical, the service will be tailored to meet the needs of each participating laboratory.

A complete transport standard of voltage. The temperature controlled enclosure (lower left) is powered during transit by the 12-volt supply at right. The shipping container (rear) protects them from extremes of shock and temperature.

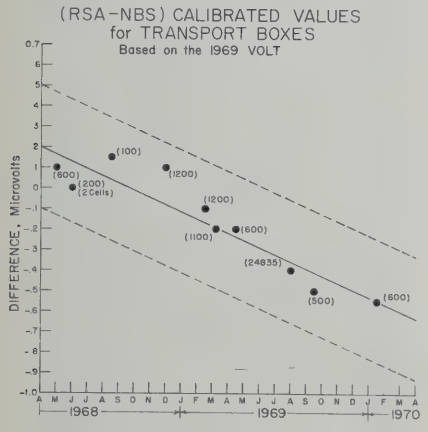
The experiment is carried out in three phases: First, NBS will analyze the participant's procedures and physical arrangement. From the analysis, NBS will propose certain internal experiments, determine various operating parameters, and establish that the local measurement process is in control. Where measurement problems are encountered, NBS will assist in solving these problems even to the extent of sending personnel to the laboratory, if necessary.

Second, NBS will provide the laboratory with a suitable transport standard (saturated cell) and pro-

cedures for intercomparing it with its reference group of standard cells. Usually, the transport standard will be shipped via air freight under carefully controlled conditions.

Finally, upon return of the transport standard, NBS will analyze the results obtained at the laboratory and at NBS, and issue a complete report giving a detailed analysis of the experiment and recommendations for changes in the laboratory's unit of voltage that might be in order.

The differences in emf of various transport standards as assigned by NBS and the Army Standards Laboratory. The numbers beside each point identify the standard. From these data the drift of the army unit of voltage relative to NBS was found to be about 0.4 μV per year.



The level of participation by each laboratory will depend on its own internal requirements. It may vary from four such experiments per year to one every two years. This type of approach eliminates several sources of uncertainty that are inherent in the regular procedure in which customers send or bring their cells to NBS. This is because the Volt Transfer Program calibrates the whole process and not just a portion of it. At the present time NBS is quoting as the standard deviation of a single experiment 0.15 ppm or a three standard deviation uncertainty for the complete calibration of 0.5 ppm. It should be again emphasized, however, that this service is *not* (at this time) meant to replace the regular calibration procedure. Rather, it is designed for those laboratories that need and can utilize the most precise unit of voltage possible to obtain.

The present cost is in the range of $500 to $1000, depending on the individual laboratory. A cost estimate to be treated as a "not to exceed" cost will be made after a preliminary study of the needs. For further technical information contact either W. G. Eicke or Bruce Field, Absolute Electrical Measurements Section, Electricity Division, National Bureau of Standards, Washington, D.C. 20234, or telephone (301) 921–2730.

BROADCAST OF NEW TIME SCALE

Since 1967 the second has been defined in terms of an atomic transition, while time scales in general use are based on the rotation of the earth. This has resulted in the dissemination of a compromise time scale arrived at by international agreement through the International Radio Consultative Committee, and maintained by the International Bureau of Time (BIH). This scale, known as Coordinated Universal Time (UTC), presently operates with a frequency offset from the atomic scale of -300×10^{-10} to approximately agree with the rotation of the earth. Occasional step adjustments in time of 0.1 second are also made to compensate for unpredictable variations in the earth's rate of rotation.

To avoid the disadvantages of having an offset frequency and fractional second step adjustments, the UTC time scale will change on 1 January 1972. The new UTC scale will operate without a frequency offset, thus providing time intervals that are exactly one second long. The scale will continue to keep in approximate agreement with earth time, known as UT1, by step adjustments of exactly one second occurring about once per year. There will be a preference of adjustments on the 1st of January and July. In any case the new UTC scale should not differ from UT1 by more than 0.7 second.

In the U.S., therefore, the NBS standard broadcast services of WWV, WWVH, WWVL, and WWVB will be changed to have zero offsets in their carrier and modulation frequencies and time signals. At 00 hours on 1 January 1972, UTC will be reset a fraction of a second, sufficient to give the new UTC scale an initial difference of an integral number of seconds (probably 10.000 seconds late) with respect to International Atomic Time (IAT) as maintained by the BIH. UTC is now about 9 seconds late compared to IAT, and during the next year the difference will probably increase to about 10 seconds; thus, the reset should be only a few hundred milliseconds. Thereafter, the difference between UTC and IAT will always be an integral number of seconds. The difference between UT1 (not UT2) and the broadcast signal will also be given after 1 January 1972, probably with a resolution of 0.1 second.

STANDARD FREQUENCY AND TIME BROADCASTS

High-frequency radio stations WWV (Fort Collins, Colo.) and WWVH (Maui, Hawaii) broadcast time signals on the Coordinated Universal Time (UTC) system as coordinated by the Bureau International de l'Heure (BIH), Paris, France. The NBS time scale, UTC(NBS), and the U.S. Naval Observatory time scale, UTC(USNO), are jointly coordinated to within $\pm$ 5 microseconds. The UTC pulses occur at intervals that are longer than one coordinate second by 300 parts in 10^{10} during 1971, due to an offset in carrier frequency coordinated by BIH. To maintain the UTC scales in close agreement with the astronomers' time, UT2, phase adjustments are made at 0000 hours Greenwich Mean Time (GMT) on the first day of a month as announced by BIH. *There will be no adjustment made on March 1, 1971.*

The low-frequency radio station WWVB (Fort Collins, Colo.) broadcasts seconds pulses without offset to make available to users the

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DEVELOPMENT OF VOLUNTARY PRODUCT STANDARDS

Consumers to Benefit from Recent Revisions

As a result of recent revisions to the Procedures for the Development of Voluntary Product Standards, the Bureau may initiate the development of voluntary standards. Previously, NBS could only develop Voluntary Product Standards at the request of outside, organized groups such as trade associations. Now, according to the revised procedures, which are published by the Department of Commerce, the Bureau may initiate a standard without an outside request if it determines that the standard would be in the public interest. Consequently, the NBS Office of Engineering Standards Services (OESS) is planning a new series of consumer product standards.

According to Donald R. Mackay, Chief of OESS, various products are now being considered as possible subjects for consumer standards. Other products may be selected for study on the basis of the findings of the National Commission on Product Safety. The new procedures will allow the OESS to act quickly to disseminate to industry and the consumer the discoveries and knowledge of other Bureau groups. For example, input from the Bureau's Glass Section might provide the basis for developing a safety standard for glass soft drink bottles. Such a standard developed in cooperation with the glass bottle manufacturers and the soft drink industry could contain requirements for thickness, weight, and distribution of glass which would reduce the possibility of explosions of these bottles.

50 Years of Standards Development

Although the new procedures make it easier to serve the needs of consumers, the voluntary standards group has actually been turning out standards that have indirectly benefited consumers for nearly 50 years. The first voluntary standards activity in the Department of Commerce was initiated in 1921 by Herbert Hoover, then Secretary of Commerce. Hoover created a Division of Simplified Practice as part of his effort to eliminate waste in industry. The Division of Simplified Practice, which later became part of NBS, worked with industries, at their request, to eliminate excess sizes, types, and kinds of manufactured articles. The lists of standard sizes and types were called Simplified Practices Recommendations (SPR).

The first industry to take advantage of the simplification program was the paving brick industry. With the aid of the Division of Simplified Practice, they reduced the sizes and varieties of paving brick from 66 to 11.

As the simplified practice program grew, so did the demand for quality standards in addition to size standards. To meet this need, a commercial standards unit was added to the simplified practice group in 1927. The unit soon grew into a separate division. The first standard issued in the new Commercial Standards (CS) series was for clinical thermometers.

In 1947, the Simplified Practice Division and the Commerce Standards Division were merged into a Commodity Standards Division. Later a reorganization of the Commerce Department led to the transfer of the Commodity Standards Division to the Department's Office of Industry and Commerce of the Bureau of Foreign and Domestic Commerce. In 1953 the Division was transferred to the Office of Technical Services under the Business and Defense Services Administration.

Even after it was separated from NBS, the Commodity Standards Division retained its contacts in the Bureau so that it could obtain technical assistance. However, the distance betwen the two groups sometimes made cooperation difficult. After several years, the close ties between the Division and the Bureau began to break down. Realizing that the Bureau's technical competence and scientific impartiality were the basis of sound commercial standards, Secretary of Commerce Luther H. Hodges transferred the Commodity Standards Division back to NBS in 1963. The reorganization was to allow the Division "to become a part of the Bureau's increased and concentrated effort on technological standards."

In December of 1965 new procedures for the development of voluntary standards by the Department of Commerce were published in the *Federal Register*. These procedures provided for greater protection of the public interest by requiring that all concerned—producers, distributors, users or consumers, and groups with a general interest—be represented during the development of a standard.

Along with the new procedures came a new name—Voluntary Product Standards. This term was to be used for all new standards and all revisions of old Commercial Standards and Simplified Practice Recommendations. In the past, there had been a clear distinction between Simplified Practice Recommendations, which recommended sizes, and Com-

Voluntary Product Standards Procedures

Interested Groups or NBS	—Requests project and prepares initial draft of standard
NBS	—Reviews and distributes draft for comment
Industry*	—Reviews proposed standard
NBS	—Adjusts standard and forms Standard Review Committee
Industry Committee*	—Approves recommended standard
NBS	—Reviews and distributes recommended standard for acceptance
Industry*	—Accepts or objects
NBS	—Considers response Publishes standard Appoints Standing Committee
Industry Committee	—Considers revisions

*The "industry" includes manufacturers, distributors, and users or consumers. It may also include special interest groups such as testing agencies or Government agencies.

mercial Standards, which established quality requirements. However, over the years, this distinction had diminished to the point where the two overlapped—many SPR's included quality requirements, and many CS's contained size recommendations. As a result, only one descriptive term was necessary. Since the standardization procedures were being revised, it was decided that the term chosen should not be taken from the past, but should instead be something new to reflect the increased emphasis on the total participation of an industry, including consumer groups; thus, the term "Voluntary Product Standard" was chosen.

Soon after the new procedures were issued, the Office of Commodity Standards became the Office of Product Standards. Then in May 1966, a reorganization of the Bureau resulted in the present name and organizational structure of the standards program. At that time, the Office of Engineering Standards Services was created to carry out three specific tasks:

1. To cooperate with and assist producers, distributors, users, and consumers of products and agencies of the Federal, State, and local governments in the development of standards for products;

2. To develop safety standards required by statute and conduct appropriate testing and evaluation; and

3. To provide information services with respect to public and private engineering standards.

Current Development Procedure

The procedures were amended May 11, 1968, and were revised May 28, 1970. The revised procedures consist of the basic steps as shown in the table above.

The procedures place heavy emphasis on the participation of as many people as possible in all segments of an industry, including the consumer segment, because Voluntary Product Standards are completely voluntary, and their usefulness depends on the amount of general recognition and acceptance they receive.

Use of Standards

Once a Voluntary Product Standard is accepted it is of value to manufacturers, distributors, purchasers, and consumers. Manufacturers and distributors can refer to the standard in sales catalogs, advertising, invoices, and labels on their products. Purchasers can order products that comply with a Voluntary Product Standard and determine for themselves that the requirements have been met. When incorporated into a legal document such as a sales contract or a purchase order, the requirements of a Voluntary Product Standard are enforceable by the purchaser (or the seller) along with the other provisions of the document. Consumers can look for reference to a standard on products and product labels when they shop.

Some examples of consumer items that carry references to standards established under the Government's voluntary standards program are:

1. *Softwood Plywood* (PS 1–66)—Each panel that complies with the standard is stamped on one or both faces or on any of the four edges.

2. *Clinical Thermometers* (PS 39–70)—The standard number is either etched in the thermometer glass or mentioned in the literature that comes with the thermometer.

3. *Plastic Garden Hose* (CS 209–57)—The standard number can be found on literature that comes with the hose (usually a cardboard insert).

Products Covered

By definition, Voluntary Product Standards may cover terms, classes, sizes, dimensions, capacities, quality levels, performance criteria and requirements, material specifications, packaging practices, inspection requirements, marking, testing equipment and procedures, installation procedures, and any other important aspect of a product. Voluntary Product Standards may be very simple and cover only one or two characteristics of a product such as a package quantity standard, or they may have detailed specifications covering a whole range of pertinent characteristics such as the softwood plywood standard. As a result, the current Voluntary Product Standards projects, approximately 80 in number, cover a variety of products. However, many of the projects can be placed under a few broad categories:

1. *Wood products*—including wood window units, hinged interior door units, hardwood and decorative plywood, and wood flush doors.

2. *Plastic products*—including several types of plastic pipe, polyethylene plastic containers for petroleum, vinyl wallcovering, vinyl garden hose, polyethylene film, and vinyl siding.

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continued from page 49

3. *School products*—including paints and inks for art education, school chalk, and school paste.

4. *Clothing*—including how to measure clothing, and body measurements for the sizing of boy's apparel, girl's apparel, and women's patterns and apparel.

5. *Weighing devices*—including vehicle and livestock scales, batching scales for construction purposes, and bathroom scales.

6. *Packaging*—including package quantities for instant nonfat dry milk, toothpaste, and instant mashed potatoes; also can sizes for vegetables, tuna, soups, and mushrooms.

7. *Health and safety*—including toy materials, clinical thermometers, and portable picnic coolers.

The *Technical News Bulletin* will carry progress reports on the current projects of the OESS. Standards that have reached milestones in the Voluntary Product Standards Procedures during the month will be listed under headings such as "Standard Circulated for Acceptance."

Anyone desiring to obtain a copy of a recommended standard or to suggest a new consumer product standard should write to:

Office of Engineering Standards Services
National Bureau of Standards
Washington, D.C. 20234

CONFERENCE & PUBLICATION *Briefs*

AN ELECTROMAGNETIC METROLOGY CURRENT-AWARENESS SERVICE

The Electromagnetic Metrology Current-Awareness Service which the Bureau has provided to the Navy metrology laboratories since July 1969 is now generally available. In this service measurement specialists of the NBS Electromagnetics Division present brief summaries of articles appearing in current publications. Because the articles are selected and the summaries are written by specialists active in research at NBS, these "abstracts" represent the technical essence of the articles—especially as they relate to metrology.

Emphasis is on measurement techniques and standards of electrical quantities ranging from dc into the millimeterwave frequencies. Quantities covered include attenuation, current, field strength, antenna gain, frequency, time, impedance, noise, phase shift, time delay, power, voltage, electromagnetic properties of materials, and radiofrequency interference/electromagnetic compatibility. Methods of analysis applicable to measurements in general are included as well as occasional related articles on design, components, management, news, etc.

Timeliness of the service is indicated by the fact that articles are reported within a month after they appear in the literature. Comprehensiveness is assured by in-depth examination of thirty-five periodicals with more to be added as they are identified as making consistent contributions to the metrology literature. In addition, abstract journals and lists of government publications are scanned for references which appear pertinent. (These references are listed without abstracts.)

Monthly reports are available by mail at the yearly rate of $100. Checks, made payable to NBS Department of Commerce, should be sent to:

Electromagnetic Metrology Information Center
Electromagnetics Division
National Bureau of Standards
Boulder, Colorado 80302

NUCLEAR INSTRUMENT MODULE SYSTEM

Development and Current Status of the Standard Nuclear Instrument Module (NIM) System, NBS Technical Note 556 [1] (30 cents; SD Catalog No. C13.46:556) edited by Louis Costrell, discusses the history and current status of the Nuclear Instrument Module (NIM) system, first formulated in 1964 through the joint efforts of the Atomic Energy Commission, the National Bureau of Standards, and leading centers of nuclear research in this country and abroad. This system is now dominant for nuclear instrumentation in most of the world and has contributed substantially to experimental nuclear and radiation physics.

Advantages of the system arise primarily from the interchangeability of the modules, which is made possible in turn by concentration on standardizing the mechanical and electrical module-bin interface. Economic optimization of instrument systems results from ability to combine instruments from numerous manufacturers. It is also possible to readily restructure systems by interchanging instruments as desired. Systems can be updated by replacing only the specific modules that become outdated. New modules are easily substituted for defective ones, enhancing serviceability and drastically reducing down time. There is a similar reduction in mechanical design effort, leav-

ing more time for innovative circuit design. There is reason to believe that the NIM system has the potential for extending to other fields these same advantages which, according to a recent report of the National Academy of Sciences, have "revolutionized the manner in which experiments are now performed in nuclear physics."

CURRENT SYMBOLS AND TERMINOLOGY IN THE FIELDS OF RADIATION, LIGHT, AND COLOR

The International Lighting Vocabulary, 3rd Edition, published jointly by the International Commission on Illumination (CIE) and the International Electrotechnical Commission (IEC), is now available. L. E. Barbrow and D. B. Judd, members of the NBS staff, were the USA participants in the international group that formulated this document. This truly monumental work includes definitions of nearly 900 terms in the fields of radiation, light, and color in four languages (English, French, German, and Russian) and translations of the terms only in five additional languages (Dutch, Italian, Polish, Spanish, and Swedish), as well as detailed alpabetical indexes in the nine languages.

The terms and their sysmbols, as well as the units employed in the vocabulary, are all in accord with the most recent resolutions and actions of international organizations such as the General Conference on Weights and Measures, the International Organization for Standardization, and the Standards, Units, and Nomenclature Commission of the International Union of Pure and Applied Physics, as well as the two sponsoring organizations (CIE and IEC). The usage in the International Lighting Vocabulary has thus received international acceptance. In the fields of radiation, light, and color, terms and symbols in American National Standards such as Z7.1–1967 approved since 1967 are consistent with those in the new International Lighting Vocabulary, but many of the terms and symbols in prior American as well as International Standards are deprecated and have been superseded by those in the Vocabulary.

The International Lighting Vocabulary may be purchased from H. K. Hammond, Secretary of the U.S. National Committee, CIE, Room B–360 POLY, NBS, Washington, D.C. 20234 for $16.00 postpaid; make check payable to *"U.S. National Committee, CIE."* Copies of Z7.1–1967 are available from the Illumination Engineering Society, 345 East 47th Street, New York, N.Y. 10017 or from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018 for $3.00

The Bureau policy is that NBS authors should use symbols and terminology for physical quantities and units that conform with national standards promulgated by the American National Standards Institute, or with international standards recommendations such as those embodied in the International Lighting Vocabulary.

BUILDING RESEARCH AT THE NATIONAL BUREAU OF STANDARDS

Building Research at the National Bureau of Standards, by Paul R. Achenbach, NBS Building Science Series O (October 1970, 59 pages, 60 cents) SD Catalog No. C13.29/2:0, describes the continuing program of building science at the National Bureau of Standards. The publication, prepared as the basic document of the NBS Building Science Series, is to serve as a key to the work of the previous 68 years and as an introduction to the future. Included are a statement of the mission of the Building Research Division, a history of the Bureau's previous activities in the area, and a summary of future objectives, together with a comprehensive bibliography. Recent reorientation of Division objectives toward the development of performance requirements and performance evaluation techniques for building components and systems is emphasized.

SCHEDULED NBS-SPONSORED CONFERENCES

Each year NBS sponsors a number of conferences covering a broad range of topics in science and technology. The conferences listed below are either sponsored or cosponsored by NBS and will be held at the Bureau's Gaithersburg, Md., facility unless otherwise indicated. These conferences are open to all interested persons unless specifically noted. If no other address is given, inquiries should be sent to the person indicated below in care of Special Activities Section, Room A600, Administration Building, National Bureau of Standards, Washington, D.C. 20234.

Second National Conference on Roofing Technology. Mar. 22–23. Cosponsor: National Roofing Contractors Association. Contact: William C. Cullen (NBS Building Research Division).

Flow—Its Measurement and Control in Science and Industry. May 10–14. Cosponsors: American Institute of Physics; American Society of Mechanical Engineers; Instrument Society of America. Contact: V. J. Giardina, Instrument Society of America, 400 Stanwix Street, Pittsburgh, Pa. 15222. To be held in Pittsburgh, Pa.

Fourth Joint Meeting of Operations Researchers. May 24–26. Sponsors: College on Logistics of the Institute for Management Sciences (TIMS); Mathematical Society of America; American Society for Cybernetics; American Society for Public Administration; Association for Computing Machinery; Operations Research Society of America. Contact: Lloyd Burden (NBS Technical Analysis Division).

Summer Symposium in Analytical Chemistry. June 16–18. Cosponsor: American Chemical Society (Division of Analytical Chemistry). Contact: R. A. Durst (NBS Analytical Chemistry Division).

Fifth Symposium on Temperature Measurement and Control in Science and Industry. June 21–24. Cosponsors: American Institute of Physics; Instrument Society of America. Contact: H. H. Plumb (NBS Heat Division).

NBS Measurement Seminars, 1971 Series. Two- to four-day courses on measurement and calibration problems. Attendance limited. See September 1970 *Technical News Bulletin* for detailed information.

NSRDS NEWS

The NSRDS was established to make critically evaluated data in the physical sciences available to science and technology on a national basis. The NSRDS is administered and coordinated by the NBS Office of Standard Reference Data.

IONIZATION POTENTIALS AND IONIZATION LIMITS

NSRDS–NBS 34, *Ionization Potentials and Ionization Limits Derived From the Analysis of Optical Spectra* [1] (75 cents, SD Catalog No. C13.48: 34), by Charlotte E. Moore, is the latest critical compilation in the NSRDS series. It contains a current table of ionization potentials expressed in electron volts and a detailed table giving limits from which they have been derived. For each spectrum the ground term is given, with the limit as the ground state. The energy levels of terms of the lowest configuration, relative to ground state zero, are also tabulated for selected spectra. Information is included which will facilitate an evaluation of the data for individual spectra. The literature references used for each spectrum are indicated by a number and listed in a bibliography with some 200 entries. The last previous compilation of this kind was prepared by the same author as Table 34 in Volume III of *Atomic Energy Levels* published in 1958 (NBS Circular 467). The present tables are based on the literature extending into 1968, as well as on some later material.

PREPRINTS ON PRECISION MEASUREMENT AND FUNDAMENTAL CONSTANTS

The enthusiastic response to the International Conference on Precision Measurement and Fundamental Constants held at the National Bureau of Standards, August 1970, has led to a proposal to establish an information center on precision physical measurement and related theoretical work relevant to the determination of the fundamental physical constants. It was felt that a center of this type, in which NBS will serve as a primary depository for information on current research, would be of value to all workers in this field. The subjects of interest are essentially identical to those discussed at the above Conference and encompass (but are not necessarily limited to): frequency and length standards; velocity of light; electrical standards; Rydberg and Faraday constants; atomic masses; precision x-ray measurements; gravitational constants (g and G); proton magnetic moment in units of the Bohr and the nuclear magneton; proton gyromagnetic ratio; macroscopic quantum phase coherence in superfluids (Josephson effects); gas constant; quantum electrodynamic theory (as applied to precision low energy experiments); lepton g-factor anomalies; fine and hyperfine structure of simple atoms; and least squares adjustments of the constants.

All workers who submit papers for outside publication that are pertinent to the areas listed above are requested to send a preprint to the Office of Standard Reference Data, National Bureau of Standards, at the time of submission. A file of these preprints will be maintained and a periodic announcement of the titles, initially bimonthly, will be distributed by OSRD, beginning in January 1971. The system will be similar to that operating in high energy physics, i.e., "Preprints in Particles and Fields." These announcements will be entitled "Preprints on Precision Measurement and Fundamental Constants," or PPMFC for short. It is expected that a list of bibliographic citations of the papers after they are published (in the language of the high energy physicists, an "antipreprint" list) will be compiled and circulated at longer intervals. In addition, the mailing will serve as a newsletter in which conferences and other matters of interest can be announced.

Interested scientists wishing to receive "Preprints on Precision Measurement and Fundamental Constants," or wishing to submit preprints of papers submitted for publication which deal with the modern theoretical developments and experimental techniques of precision physical measurement as applied to the determina-

tion of the fundamental constants, should send their request and/or papers to:

PPMFC
Office of Standard Reference Data
National Bureau of Standards
Washington, D.C. 20234
U.S.A.

The title of the journal to which the paper has been submitted should be included. This may be handwritten on the first page of the paper. B. N. Taylor and D. R. Lide, Jr., are serving as editors.

THERMODYNAMIC PROPERTIES OF FLUORINE

NBS Technical Note 392, the *Thermodynamic Properties of Compressed Gaseous and Liquid Fluorine* [1] ($1.50, SD Catalog No. C13.46:392), by Rolf Prydz and Gerald C. Straty, presents temperature, pressure, and density data for fluorine as measured over the ranges of 53 to 300 K, 0.0003 to 24 MN/m^2 (1 MN/m^2 = 145 psi), and 0.03 to 45 moles per liter. Values of the isothermal and isochoric derivatives, second and third virial coefficients, internal energy, enthalpy, entropy, specific heats (C_v and C_p) and velocity of sound are calculated from these data and tabulated at intervals of 2 or 5 K.

Fluorine, one of the most energetic oxidizers known, is being considered as a propellant (in combination with hydrogen) for the upper stages of rockets. The hydrogen-fluorine propellant system has a specific impulse higher than any other stable chemical combination. In the chemical industry, fluorine is used to produce many important industrial materials, including various fluoroplastics.

However, the highly toxic and reactive properties of fluorine have hindered and discouraged research on its physical properties. Thus, data on fluorine tend to be inaccurate, scarce, and for many regions of the PVT surface, nonexistent. This definitive study supplies much-needed data, thus facilitating engineering calculations and systems development.

Discussed in the Note are the principal methods currently used for PVT measurements along with the advantages of the gas expansion method employed in this particular project. The experimental apparatus and procedure are detailed extensively, as are the computational techniques and principles involved in deriving the tabulated thermodynamic quantities.

SURVEY OF ELECTRICAL RESISTIVITY

NBS Technical Note 365–1. *Survey of Electrical Resistivity Measurements on 8 Additional Pure Metals in the Temperature Range 0 to 273 K*,[1] ($1.00, C13.46:365–1), by L. A. Hall and F. E. E. Germann, extends the work done by Hall (Technical Note 365, February 1968) on electrical resistivity measurements of pure metals by surveying the experimental data for 8 more metals: cadmium, chromium, manganese, titanium, tungsten, vanadium, zinc, and zirconium. The previous work covered 16 metals: aluminum, beryllium, cobalt, copper, gold, indium, iron, lead, magnesium, molybdenum, nickel, niobium, platinum, silver, tantalum, and tin. The compilation of data was based on a computer search of articles published in primary scientific and technical journals, and secondary publications such as *Chemical Abstracts, Physics Abstracts, NASA STAR, Nuclear Science Abstracts, DDC TAB,* and *International Aerospace Abstracts.*

The survey was restricted to measurements of temperature-dependent resistivity in very pure metals between the temperatures of 0 and 273 K. Each metal is given a separate section, consisting of sources of data, additional references of possible interest, comments by the authors on the factors influencing the character of the experimenter's data (e.g. purity, heat treatment, structure, etc.) tables of data, and a graph of the ratio of resistivity at a given temperature to resistivity at 273.15 K, versus temperature. A brief, general discussion of resistivity in metals is presented, along with an explanation of the use of the data in predicting the resistivity of a particular metal. The organization of the material presented indicates the areas of incomplete data, and permits the experimentalist to aim his work toward the regions of greatest need.

TRANSLATION FROM THE SOVIET STANDARD REFERENCE DATA SYSTEM

Another publication from the U.S.S.R. Committee of Standards, Measures and Measuring Instruments, apparently in the series initiated by GSSD (State Service and Reference Data), has been translated and published for the U.S. Department of Commerce and the National Science Foundation. It is Series of Monographs No. 4, *Thermophysical Properties of Gaseous and Liquid Methane,* by V. A. Zagoruchenko and A. M. Zhuravlev.

This monograph contains a critical analysis of experimental data and tables already published on the thermodynamic properties of methane. The monograph describes a method for setting up the equations of state for the gas and liquid phases according to experimental data, and lists the equation constants. Tables were compiled listing the specific volume, and enthalpy, entropy, specific heats at constant pressure and volume, and the velocity of sound propagation in gaseous and liquid methane, from the saturation curve to a temperature of 1000 K and a pressure of 1000 bar. The experimental data on the transport coefficients are correlated, and the best conductivity and viscosity coefficients, as well as the Prandtl numbers, are listed for temperatures of up to 500 K and pressures up to 500 bar. An extensive bibliography of world literature is included. Copies of this compilation are available from the National Technical Information Service, Springfield, Va. 22151, for $3. Publication No. TT70–50097 should be included in the ordering information.

STANDARD X-RAY DIFFRACTION POWDER PATTERNS

Standard X-Ray Diffraction Pow-

der Patterns [1] ($1.50, SD Catalog No. C13.44:25), by Howard E. Swanson, Howard F. McMurdie, Marlene C. Morris, and Eloise H. Evans, is the eighteenth in a series of publications [2] by the National Bureau of Standards containing information on x-ray diffraction powder patterns. In this installment, standard x-ray diffraction patterns are presented for 81 substances, of which 53 represent experimental data and 28 are calculated. The information is gathered, evaluated, and in part generated (by laboratory measurements) at NBS as part of a continuing program to extend and update the Powder Diffraction File, a compilation of patterns from many sources, under the auspices of the Joint Committee on Powder Diffraction Standards. The committee, which partially supports the NBS work, is made up of representatives of the American Society for Testing and Materials, the American Crystallographic Association, the (British) Institute of Physics, and the National Association of Corrosion Engineers.

The experiment-based x-ray powder diffraction patterns in the present publication were obtained with an x-ray diffractometer, using samples of high purity. All d-values were assigned Miller indices determined by comparison with computed interplanar spacings and from consideration of space group extinctions. Densities and lattice constants were calculated, and refractive indices were measured wherever possible. The calculated x-ray powder diffraction patterns were computed from published crystal structure data. Both peak height and integrated intensities are reported for the calculated patterns. A cumulative index covers the contents of all 18 publications in the series.

THERMAL CONDUCTIVITY AWARD

For the past ten years, an annual conference on thermal conductivity has been held. The first was organized by Mr. C. F. Lucks of the Battelle Memorial Institute, and to mark the occasion of the Tenth Conference, held September 28–30, 1970, in the Marriott Motor Hotel, Newton, Mass., Mr. Lucks donated a suitably mounted piece of Armco iron to be awarded annually for notable contributions to the subject of thermal conductivity. The choice of Armco iron was appropriate since this metal has frequently been used as a thermal conductivity reference material and the particular piece donated came from a stock obtained for a round robin series of determinations which had been initiated by the Battelle Memorial Institute.

The recipient named as the first holder of this award is Dr. R. W. Powell, Senior Researcher at the Thermophysical Properties Research Center, and when making the presentation at the Conference Banquet, Mr. Lucks mentioned Dr. Powell's 1934 paper on the thermal and electrical conductivities of Armco iron to 800 °C as the first of many important papers in this field. This early work had been undertaken at the National Physical Laboratory, Teddington, England, where Dr. Powell was head of the Thermal Properties Section prior to coming to Purdue University at the beginning of 1965.

The materials he investigated at that Laboratory included carbons and graphites, metals and alloys, oxides, refractory compounds, pure liquids and liquid refrigerants. Also, it was there that in 1956 he developed the Thermal Comparator, which still serves as the basis of a useful and rapid method for the comparative determination of the thermal conductivities of solids, liquids and gases.

Since joining TPRC, Dr. Powell has been co-author of several reports, including NSRDS–NBS–8, Part 1,* and NSRDS–NBS–16, Part 2, Thermal Conductivity of Selected Materials (C13.48:16/Pt. 2),[1] $2, containing valuable assessments of heat conduction data, has helped with the setting up of a laboratory for thermal property measurements, and initiated the program of work on the direct electrical heating methods, which is now under the direction of Dr. R. E. Taylor.

*Available from the National Technical Information Service, Springfield, Virginia 22151, for $3. Use order number PB 18698.

SFCSI LIST OF TRANSLATIONS

The National Science Foundation has announced and published a list of translations in process under the Special Foreign Currency Science Information Program (SFCSI) for calendar year 1970, as well as some titles that were submitted in late 1969.

As translations are completed, they are announced in the journal *U.S. Government Research and Development Reports* (*USGRDR*) as available from the National Technical Information Service. Most of the items are priced at $3 for paper copy and 65 cents for microfiche. Entries preceded by an asterisk are available from the sponsoring agency only.

Not included in this list are drafts of manuscript type translations of fishery and oceanography literature from Russian, Japanese, Polish, Serbo-Croatian, German, and other languages that are done for the Bureau of Commercial Fisheries for internal use. These translations are listed in information releases published by the Office of Foreign Fisheries (Translations), U.S. Department of the Interior (Room 8015), Washington, D.C. 20240, and are available on loan to U.S. Government agencies.

A brief history of the Special Foreign Currency Science Information Program is included in the Sept. 1970 issue. The SFCSI List may be obtained from the National Technical Information Service, Sills Building, Springfield, Va. 22151.

[1] Order by SD Catalog Number from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for the price indicated.

[2] The first ten publications in the series were NBS Circular 539, Standard X-ray Diffraction Powder Patterns, Volumes 1 through 10. Information on these is available from Mr. H. E. Swanson, Materials Building, A221, National Bureau of Standards, Washington, D.C. 20234. The next publications in the series were Sections 1 through 7 of NBS Monograph 25, available from the Superintendent of Documents at the following prices: Sect. 1, 40 cents; Sect. 2, 35 cents; Sect. 3, 40 cents; Sect. 4, 55 cents; Sect. 5, 55 cents; Sect. 6, 60 cents; Sect. 7, $1.50. (Order PREPAID as SD Catalog No. C13.44:25/Sect. 1-7.)

FIPS NOTES

CONFERENCE ON THE MANAGEMENT OF COMPUTER SYSTEMS IN THE FEDERAL GOVERNMENT

THE FOLLOWING ARTICLE IS A report of a Conference on the Management of Computer Systems in the Federal Government held in Myrtle Beach, S. Car., in July 1970. The article was prepared by the ADP Management Staff of the Office of Management and Budget and summarizes the consensus of the conference participants.

The purpose of the Conference was to:

1. Review developments and Government actions that have been initiated since a similar conference held in September 1969 at Charlottesville, Va., including the procurement of peripheral equipment from independent suppliers and the acquisition of computer systems in a multivendor environment.

2. Consider the development of interface standards to facilitate multivendor procurements, and the exchange of information on the characteristics of vendors' products.

3. Consider other issues that are of current interest, including the use of benchmarks and simulators in the solicitation and evaluation of vendors' proposals, Government-wide coordination of the acquisition and use of software, and economic considerations involving residual values and long-term leasing.

The Conference was attended by 40 top management officials from ten Government agencies, the Interagency Committee on ADP, the General Accounting Office, and various segments of the computer industry, including system suppliers, independent peripheral suppliers, and independent software suppliers.

PROCUREMENT OF PERIPHERAL EQUIPMENT

The General Services Administration (GSA) reported that cost reductions approximating $5,000,000 in annual rentals are in prospect as a result of the Government-wide program initiated after the Charlottesville Conference to replace existing leased peripheral devices with lower-cost, plug-to-plug compatible equipment offered by independent suppliers. Using the ADP Management Information System, about 3000 tape and disk drives being leased by Government agencies from system suppliers were reviewed for potential replacement by independent suppliers. About 2100 of these are the subject of current replacement actions. Reports from agencies in which replacements have already been effected indicate that performance has been satisfactory.

While the foregoing program is directed at the easier task of replacing equipment that is already being leased and operated, work is also proceeding to test the feasibility and advantages of selecting and procuring independent peripheral devices during the initial selection and procurement of an ADP system. The General Services Administration has structured and issued a Request for Proposals for the procurement of a system which will permit competitive offers by independent suppliers and others to supply all or any part of the system requirements, with safeguards to assure total system compatibility. Assuming satisfactory responses, selection and award is expected in February 1971. Surprisingly, little interest has been shown in this procurement by independent peripheral and software suppliers, as reflected by their lack of attendance at a vendors' conference on this RFP.

I/O INTERFACE STANDARDS

The continuing urgency of the need expressed at the Charlottesville Conference for appropriate I/O interface standards was reaffirmed. These standards would provide the flexibility needed by users for the selective configuration of computer systems to achieve required performance at least cost, and to facilitate the kind of multivendor procurements which GSA is now testing.

There appears to be almost no question that the development of interface standards is technically feasible. Whether standardization is, in fact, accomplished at the American National Standards Institute (ANSI) level seems to depend upon whether the competitive interests of the computer industry can be resolved to the benefit of the user community.

In furtherance of the recommendations of the Charlottesville Conference, the National Bureau of Standards reported that the X3T9 Committee (ANSI), which has I/O standards responsibility, had recently received and is considering two industry proposals for standardization at the channel level, and hopes to recommend a draft standard by April 1971, after which the Committee would immediately begin the development of standards needed at the device level.

Although there is some doubt whether the April 1971 schedule will be met, the current activity in X3T9 suggests that the Government should continue to lend the full weight of its support in helping X3T9 achieve its objective for a channel interface standard. This would have the advantage of simplifying the subsequent development of interface standards for selected classes of peripheral devices. To accelerate this development, the Government has initiated work toward formulating a proposal for a tape device interface standard, which could be presented for X3T9 priority consideration by the spring or summer of 1971.

On a shorter range basis, a number of alternatives could be pursued to reduce the cost of currently leased peripheral devices for which independent plug-to-plug compatible equipment is not available on the market. These are:

1. Purchase the currently leased devices, taking advantage of accrued rental credits. This alternative is, of course, valid only if usage beyond the break-even point is anticipated.

2. Solicit proposals for replacement of selected models of peripheral devices, giving the option to the potential supplier for bidding equipment which is directly plug-to-plug compatible or capable of being interconnected through an adaptor device furnished by the supplier. Such solicitations would be feasible from a cost standpoint only for those devices for which there are a sufficient number in the Government inventory to provide an attractive market for the potential suppliers. This approach prop-

erly places responsibility for compatibility upon the supplier of the peripheral device and enables the competitive forces in the marketplace to operate in supplying the required compatibility at least cost to the Government.

3. Develop, in-house or by contract, a "black box adaptor" that would permit the interconnection of independent peripheral devices with existing computer main frames. Such adaptors could be procured in quantity and obtained by those users desiring to effect replacements. This approach appears less desirable than alternative 2; it is potentially more costly and injects an additional factor into the user/main frame and peripheral supplier relationships which could obscure the responsibility for total system performance.

EVALUATION OF PROPOSALS: BENCHMARKS AND SIMULATIONS

It was generally agreed that the time and cost of the selection process have become excessive for both the vendor and the customer, and that the objective of streamlining the process should be a continuing concern of the Government.

Some dissatisfaction over the use of benchmarking as an evaluation technique was expressed on the grounds that:

1. Benchmarks do not always reflect the work that is actually performed when the system becomes operational and therefore the wrong system may, in fact, be selected, and

2. Benchmarking may be so expensive to the vendor that it tends to eliminate from competition those vendors who are not able to risk the cost of competing on each procurement.

On the other hand, benchmarking was regarded as a proven and reliable technique for evaluating total system performance "before buying," and is particularly justified in the selection of large, multiple systems where the cost of benchmarking relative to the total procurement cost is within acceptable range. In this context benchmarks might not be a suitable requirement in smaller procurements (e.g., single system procurements within defined dollar limits). In these instances greater use should be made of in-house technical evaluations, including the use of simulation packages, although such evaluations should continue to be based upon well-defined system requirements.

It was suggested that consideration be given to the procedure whereby a conditional selection would be made from an initial evaluation of vendors' proposals and only the selected vendor would be required to perform the benchmark as proof of his ability to perform. While this may have merit, it could potentially extend the time of the selection process if the initially selected vendor failed the benchmark and other vendors had to perform in sequential fashion.

Simulation packages can be useful in evaluating smaller systems where the costs of full-fledged benchmarks may not be justifiable, and also in larger systems for those workload segments that cannot be accurately represented in benchmarks, such as in the use of a large number of remote terminals.

Simulation packages were also regarded as helpful in designing systems and analyzing them to gain more efficient performance. They are also helpful in definition and selection of representative benchmarks. Their utility should increase over the next several years as their reliability is more firmly entrenched and as systems become more complex.

It was felt, however, that several problems need to be resolved before simulation packages can become commonly used in the evaluation and selection process. First, simulator calibration must be better understood. Second, ways must be found to assure that the factors library (hardware and software design features, etc.) from which the simulation models are designed is both accurate and currently maintained. Finally, the relationships and responsibilities of the parties concerned (i.e., customer, systems vendor, and commercial simulation package vendor) must be more thoroughly understood and accepted, particularly in regard to the need for full mutual disclosure of information if proper simulations are to result.

ECONOMIC CONSIDERATIONS; RESIDUAL VALUES AND LONG-TERM LEASING

The Government should have the flexibility to fund ADP acquisitions in the most economical manner, but is sometimes restricted in this objective by the absence of generally accepted guidelines for determining future residual values, insufficient capitalization of the General Services Administration's ADP Revolving Fund, and limitations on the obligation of long-term leases.

The inclusion of residual value as a factor in purchase/lease decisions adds weight to the purchase side. Its importance is therefore highlighted in those cases when the purchase decision, without regard to residual value, is close or the competition for capital funds is keen and the inclusion of a residual value would more clearly demonstrate the potential economic benefits of purchase. When the anticipated use of the ADP system easily exceeds the break-even point without regard to residual value, the injection of this factor into the analysis adds little to management's decision to purchase. Although Office of Management and Budget Circular No. A–54 identifies residual value as a factor to be taken into account, the absence of generally accepted guidelines for determining such values in the context of a relatively new and dynamic technological environment has prevented uniform application of this policy. The absence of such guidelines is particularly crucial in considering residual value as a factor in the initial selecton and acquisition of ADP systems. Without such guidelines, judgmental considerations of the probable residual values of competing systems would undoubtedly form the basis for substantial protests by losing vendors.

The Department of Defense reported upon its study project to develop an approach for determining residual values, which is based on the age of the system and the probability of secondary use within the Government. The study should be closely followed to determine whether its results have applicability on a broad basis.

When outright purchase of equipment is not justified or cannot be accomplished with available funds, long-term leasing may be a more attractive alternative than the short-term rental agreements normally entered into. In some cases, long-term leasing is restricted by the Anti-Deficiency Act which requires that funds initially be obligated to cover anticipated payments over the total length of the lease. Nevertheless, it was felt that agencies may not be giving adequate consideration to this lower cost alternative for those systems now being rented by agencies under certain Federal Supply Schedule contracts which also offer longer term arrangements which, in effect, constitute a one-year rental contract with an option to renew. This option-to-renew feature permits agencies to use one-year funds without violating the Anti-Deficiency Act. All agencies should review their short-term rental agreements for possible conversion to this type of longer term arrangement in order to obtain the lower rates inherent in these agreements.

It was noted that the General Services Administration ADP Fund, authorized by Public Law 89–306 (Brooks Bill), provides a flexible mechanism for funding equipment purchases or long-term contracts in behalf of using agencies. However, the limited capital currently available in the Fund has restricted its procurement use essentially to cases where special, unexpected, and attractive purchase offers have been received by agencies who do not have sufficient funds readily available to accept the offers. The fact that the guidelines under which the ADP Fund is used are apparently not well understood was highlighted, with the suggestion that these be more widely publicized for the information and benefit of the agencies.

GOVERNMENT-WIDE COORDINATION OF THE ACQUISITION AND USE OF SOFTWARE

Current General Services Administration regulations governing agency procurement

of software are too loosely drawn to provide an effective base for coordinating the acquisition and use of commercial software products. They require GSA review and approval only if, in the judgment of the agency, the software has the potential for substantial use elsewhere. Because of the judgmental factor, agencies can decide, rightly or wrongly, not to submit the proposed procurement to GSA. The regulations should be changed to provide for GSA review of all such proposed software procurements that exceed a specified dollar level. This would have the effect of removing the judgmental factor and bring under management review all proposed procurements of sufficient value to warrant a coordinated approach for the purpose of extending the utility of the software and reducing its cost. Proposed wording of a revised regulation is:

> "Agencies may procure existing general purpose commercial software products for use with ADPE from any other source without prior review and approval of GSA *provided* that the total procurement for the specific software package does not exceed $_____ annual lease cost or $_____ purchase cost (or permanent-license-to-use cost)."

The lack of information regarding the Government's present use of software packages was also cited as a deterrent to wider and less costly use of these packages. Therefore, consideration should be given to taking an inventory of software in use by Government agencies, whether through the purchase of a permanent usage license or lease, either on a one time or continuing basis. To minimize the reporting burden, a one time report is preferred as a means for confirming the usefulness of the information before any judgment is formed on the need for this information on a continuing basis. The report should include the following information: agency, location, contractor, name of package, date installed, date projected for release, monthly rental, and purchase price.

Consideration was given to the proposition that software packages acquired for Government use ought to be supplied in standard languages to promote their utility and reduce their cost to the Government. It was noted that the use of standard languages is quite different for software to be developed specifically by or for the Government as compared with software which is an existing, commercially available, program product to be licensed for use by the Government. In the case of the former, the advantages to the Government of using standard languages are generally well recognized and should be encouraged, if not required, by all levels of the Government. In the case of licensed program products, the situation is a bit more complex. The vendor may be reluctant to provide the product in a standard language because:

1. The efficiency of the program for use on a specific system may be sacrificed by the use of a standard language.
2. The vendor wants to protect any unique ideas contained in the program and to inhibit its unlicensed use. Publishing products in standard source languages could work against these vendor interests.

On the other hand, the Government's interests, and those of other large users, argue for the use of standard languages to facilitate the use of the product across a wider range of equipment models.

The Government must make sure in negotiating contracts that in all cases it gets adequate documentation to use the product in the first place, and that some provisions are made in the contract to get source language statements and program maintenance documentation in the event the vendor becomes unwilling or unable to maintain the program. Some unique techniques may be required to accomplish this, such as depositing the documentation in a bank or with some third party who can act as a custodian of a trust. This issue should be considered further by the GSA in contractual negotiations for FY 1972.

INFORMATION EXCHANGE

The proposal developed as a result of the Charlottesville Conference for a catalog of selected hardware and software products to assist the user in selecting and modifying ADP systems components in an unbundled environment was considered to be conceptually sound. However, in view of potential magnitude of the task involved in developing and maintaining the catalog, and the potential unwieldy size of the catalog itself, some selectivity should be exercised in determining its contents. The following guidelines should be considered:

1. Limit the catalog to recent product developments and exclude products approaching the end of their technological life.
2. Include only those software products which are recognized as completely documented and operationally satisfactory.
3. In building the catalog, establish the following order of priorities within each of the following categories:

For hardware products:

a. disk packs
b. remote terminals and associated devices [e.g., cathode ray tubes (CRT's) and modems]
c. data entry devices [including optical character recognition (OCR)
d. auxiliary storage units (usually core)
e. newly offered central processing units (CPU's), especially minicomputers.

For software products:

a. general purpose operating systems, including executives
b. general purpose utility programs (compilers, sorts, merges)
c. general purpose data management systems
d. general purpose simulation packages.

4. Defer the cataloging of applications packages until an acceptable format and method for describing the packages have been established by the National Bureau of Standards. When applications packages are cataloged, only those of fairly common use should be included.
5. Initiate the identification and description of products as a useful first phase of the catalog. The Business Equipment Manufacturers Association (BEMA), Association of Independent Software Companies (AISC), and the Computer Peripheral Manufacturers Association (CPMA) might function as channels for obtaining valid and current data from the suppliers regarding their products. The extension of the catalog to include a validation of the performance characteristics claimed by the supplier and an evaluation of that performance continues to pose some questions relative to the "Qualified Products List" maintained by GSA and these should be examined and resolved by NBS and GSA.
6. Survey the existence and utility of commercial catalogs of various types for the purpose of avoiding duplicate effort if any of these serve the Government's purpose at reasonable cost.

With respect to a medium for the exchange of information regarding research and development activities, there was some question whether the need of agencies generally for such information warranted the effort that would be needed to get it. It was pointed out that perhaps four agencies would have the greatest interest—Department of Defense, National Aeronautics and Space Administration, Atomic Energy Commission, and National Bureau of Standards—and that an exchange mechanism to service these agencies on a routine basis might be appropriate. This could be supplemented with an advisory service in NBS where other agencies could seek information as the need arose.

With respect to a medium for the exchange of information on computer programs, it was noted that the success of any such effort depends to a large extent upon the adequacy and consistency of the program documentation. A prerequisite, therefore, to the initiation of such a project is the development of documentation guidelines which would form the base for describing and achieving an understanding of the programs and their potential use by others. This subject should be explored further to identify the potential value of such an exchange, its means for implementation, and its probable cost.

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the X-axis of an X-Y recorder and the mutual inductance output to the Y-axis.

Data were obtained on the specimens after from 10 to 20 temperature cycles between room and helium temperatures over a twenty-month period. Except for tin and cadmium, the transitions were no broader than a millikelvin, which compares favorably with results reported in the literature. The transitions also remained narrow and reproducible after the cycling (table 1).

Further work on superconductive fixed points is planned at NBS to include other superconductors of both higher and lower transition temperatures and to determine the dependences of the transitions upon sample purity and preparation.

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two organizations instead of a single one. It appears that we can safely depend on a continuation and increase in the efforts already being made by ISO and IEC to work together with maximum coordination and minimum duplication of effort rather than striving for self-serving dominance in particular areas.

This happy situation stems in considerable part from the fortunate circumstances that the headquarters of ISO and IEC are located alongside each other and that their administrative staffs are compatible, enjoy each other's respect and confidence and are energetic and diligent in keeping each other informed of developments in which they have a common interest. While there is no urgent need for action towards amalgamation, advantage should be taken of continuing opportunities for each organization to study the procedures of the other and to achieve improvements that may be made by common adoption of the best features of both.

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standard of frequency so that absolute frequency comparisons may be made directly, following the Stepped Atomic Time (SAT) system. Step time adjustments of 200 ms are made at 0000 hours GMT on the first day of a month when necessary. BIH announces when such adjustments should be made in the scale to maintain the seconds pulses within about 100 ms of UT2. *There will be no adjustment made on March 1, 1971.*

NBS obtains daily UT2 information from forecasts of extrapolated UT2 clock readings provided by the U.S. Naval Observatory with whom NBS maintains close cooperation.

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The diophantine approximation of roots of positive integers. Charles F. Osgood.

The minimum number of problems to cover all subproblems. H. J. Greenberg.

Error estimates for the solution of linear algebraic systems. Brother Kenneth E. Fitzgerald, F.S.C.

On the singular values of a product matrices. William Watkins.

Contractifiable semigroups. Philip R. Meyers.

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